Electronic Services - Los Angele
M13807X

PRELIMINARY
OPERATING INSTRUCTIONS
1507-5A

MODEL GFD-3
SUBCARRIER DISCRIMINATOR
DATA Control Sys

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Data- Control Systems, Inc.
Danbury, Connecticut

2-60

SECTION I

INSTALLATION

A. Power:

Power requirements for the GFD-3 Subcrarier Discriminator are 105 - 125 volts at 55 - 65 cps. No external regulation is required if line is maintained within these limits.

B. Cooling:

Provisions should be made for rear cooling of the GFD-3 Subcarrier Discriminator with moving air at an ambient temperature less than 40°C. Stability of the unit and component life will be impaired if excessive cooling air temperatures prevail. Higher air temperatures may be tolerated if air flow is sufficient. Rear heat sink temperature should be maintained at less than 60°C. A thermostat, mounted on the heat sink, is brought out through pins 11 and 12 of the rear chassis connector. This thermostat closes at 70°C. Current rating on this thermostat is 1 ampere.

SECTION II

OPERATION

A. Plug Connections:

The plug at the rear of the GFD-3 Subcarrier Discriminator is a Cannon connector type DPX-25-C3-34P. Mating connector DPX-25-C3-33S is supplied with the unit along with three coaxial connectors for RG-174/U. Before operating the unit the mating connector should be wired according to the tables included on the GFD-3 Outline Drawing, DO-007415-01. Plug should be wired according to "Normal Operation" table. Modifications may be made according to table for "Automatic Tape Speed Compensation" and "Automatic Standardization". Connections may NOT be made to the rear connector that interfere with the operation of the unit as listed under the connector "Description" table.

B. Channel Selection:

A plug-in unit for the channel to be used should be selected and a low-pass filter unit of appropriate cut-off frequency installed. (This unit is inserted from rear of channel selector with channel tag oriented so that the numbers are erect when viewed from front of unit; unit snaps into place when pushed all the way in.) The IRIG nominal intelligence for the channel used is suggested as the low-pass filter cut-off frequency, but others may be used. After installing the low-pass filter, the entire channel selector is plugged into the front of the discriminator with the locking lever in the lock position. To remove, put locking lever in the unlock position and pull entire plug-in unit from discriminator. To remove low pass unit from channel selector, press spring tab on top back of low-pass unit downward to release, and can will slide out. When unit is to be mounted in a GMH-3, connect rear chassis connector coil cord. Push GFD-3 into GMH-3 until GFD-3 snaps into place. To remove, push GFD-3 locking lever to the "release" position and pull GFD-3 out of GMH-3 by means of the channel selector handle.

C. Power:

Power is applied to the unit by depressing the toggle switch marked "Power" on the front panel. After a five-minute warm-up, adjustment of the unit can begin. Drift specifications require a 15-minute warm-up before 0.3% full bandwidth long term stability can be assumed.

D. Band Center Adjustment:

Band center adjustment is made by applying to the input terminals a band center frequency carrier with an amplitude between 10 millivolts and 10 volts. With levels in this range, the input level meter at the left of the front panel should read in the green region of its scale. The screwdriver adjustment located on the channel selector handle is used to adjust the output meter to center scale. (This is a ten-turn potentiometer.)

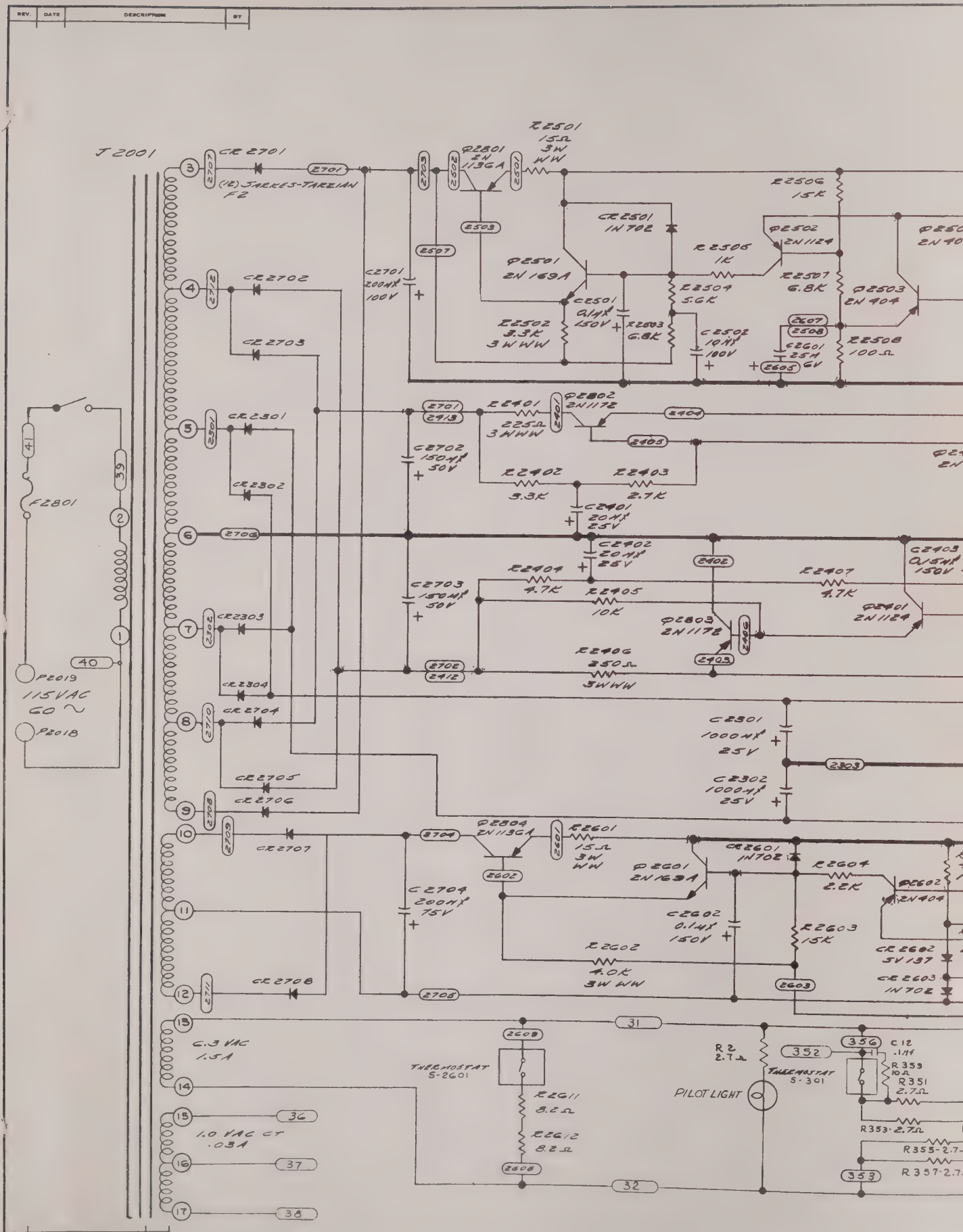
E. Output:

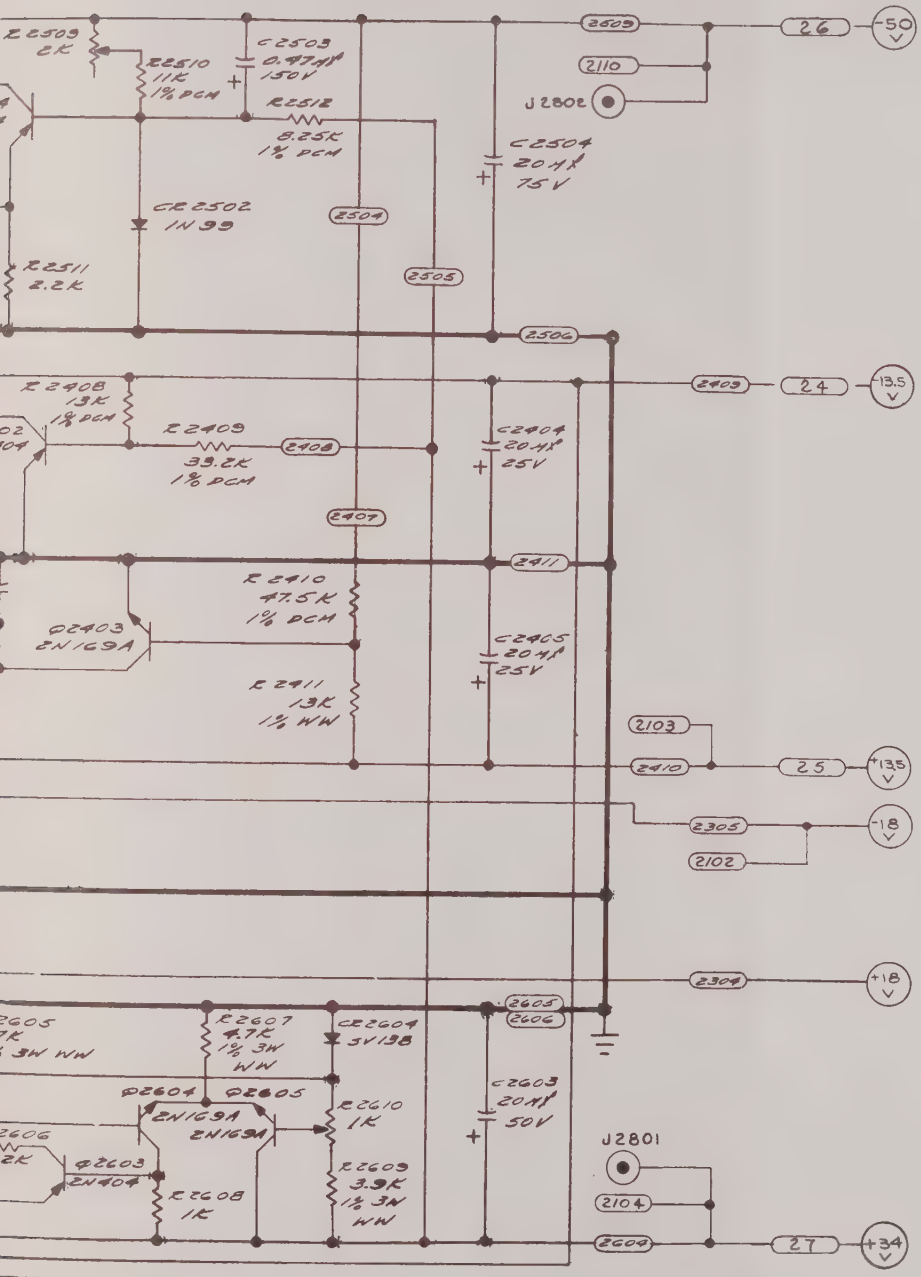
The output level control labeled "Output Volts at Band Edge" on the right side of the fron panel may be used to set the band edge voltage. Band edge voltage is continuously variable from 1 volt to 10 volts at band edge by means of a nine turn potentiometer calibrated to 1% of full potentiometer setting. Output of the discriminator is accessible through a blue front panel monitor jack located to the left of the "Output Volts at Band Edge" dial. Output will be approximately at band center with insufficient input voltage.

F. Input Monitor:

The green input monitor jack is located on the front panel to the right of the input level meter. Input monitor is also brought to pin 8 on the rear chassis connector. This signal is the output of the band-pass input filter in series with 47K.

Att. GFD-3 Outline Dwg., DCS No. DW-007415
Schematic (no number assigned as yet)


REV. DATE DESCRIPTION BY
J 2001
CR 2701
(12) SARKES-TARZIAN F2
CR 2702
CR 2703
CR 2301
CR 2302
CR 2303
CR 2304
CR 2704
CR 2705
CR 2706
CR 2707
CR 2708
C2701 200MF 100V
C2702 150MF 50V
C2703 150MF 50V
C2704 200MF 75V
C2301 1000MF 25V
C2302 1000MF 25V
Q2801 2N 113GA
R2501 15Ω 3W WW
Q2501 2N 169A
R2502 3.3K 3W WW
C2501 0.1MF 150V
R2503 6.8K
C2502 10MF 100V
R2504 5.6K
R2505 1K
CR2501 IN702
Q2502 2N1124
R2506 15K
R2507 6.8K
Q2503 2N 404
R2508 100Ω
C2601 25MF 6V
Q2802 2N1172
R2401 225Ω 3W WW
R2402 3.3K
R2403 2.7K
C2401 20MF 25V
C2402 20MF 25V
R2404 4.7K
R2405 10K
Q2803 2N1172
R2406 250Ω 3W WW
R2407 4.7K
C2403 0.1MF 150V
Q2401 2N1124
Q2804 2N1196A
R2601 15Ω 3W WW
Q2601 2N169A
CR2601 IN702
R2604 2.2K
Q2602 2N404
C2602 0.1MF 150V
R2603 15K
R2602 4.0K 3W WW
CR 2602 5V 1/37
CR 2603 IN702
F2801
P2019 115VAC 60 ~
P2018
C.3 VAC 1.5A
1.0 VAC CT .03A
THERMOSTAT S-2601
R2611 8.2Ω
R2612 8.2Ω
PILOT LIGHT
R2 2.7Ω
THERMOSTAT S-301
C12 .1MF
R359 10Ω
R351 2.7Ω
R353 2.7Ω
R355 2.7
R357 2.7
REF DESCRIPTION QTY



FRONT CONNECTOR P0001		
PIN	FROM	CIRCUIT
1	N.C	~
2	N.C	~
3	N.C	~
4	N.C	~
5	P2006	OUTPUT (CURRENT)*
6	P2005	OUTPUT METER *
7	POWER AMP. CARD	INPUT POWER STAGE
8	GND	INPUT POWER STAGE
9	GND	~
10	P2003	EXTERNAL 2ND CARD OFFSET*
11	POWER AMP CARD	OUTPUT POWER STAGE
12	P2004	OUTPUT (VOLTAGE)*
13	P2009	WIPER AUTO-CAL POT. *
14	GND	~
15	GND	~
16	OUTPUT LIMITER CARD	OUTPUT LIMITER FEED BACK
17	GND	~
18	GND	~
19	N.C.	~
20	P2021	NOW & FLUTTER INPUT *
21	N.C.	~
22	P2000-A,3,5,17,20 AND 22,23	CIRCUIT GROUND*
23	GND	~
24	2400 CARD	-13.5 V. DC
25	2400 CARD	+13.5 V. DC
26	2500 CARD	-50 V. DC
27	2600 CARD	+34 V. DC
28	P2008	INPUT MONITOR*
29	N.C.	~
30	N.C.	~
31	T2001-13	6.3 V. AC
32	T2001-14	6.3 V. AC
33	N.C	~
34	N.C	~
35	N.C	~
36	T2001-15	1VAC
37	T2001-16	1VAC CT
38	T2001-17	1VAC
39	T2001-2	PRI. PWR XFMR.
40	P3018 P2001-1	PRI. PWR XFMR. *
41	F2801	AC LINE FUSE

* STRAIGHT THROUGH CONNECTION BETWEEN 41PINELCO & P2000

DATA CONTROL SYSTEMS, INC.

TITLE: SCHEMATIC, GFD-3/5 POWER SUPPLY

TOLERANCES UNLESS OTHERWISE SPECIFIED
DECIMAL - 3 PLACE ± .005
DECIMAL - 2 PLACE ± .010
FRAC. ± 1/64 ANG. ± 0°30'
FLATNESS WITHIN /IN.
FRACTIONAL HOLES ø. + 1/64
NOTE: BREAK ALL SHARP CORNERS .005"- .015"

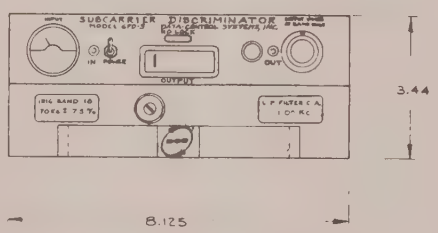
		DATE
DWN.	WK	7/1/60
CHKD.	JRR	7/1/60
PROJ. ENG.	RAR (M)	7/1/60
CH. ENG.		7/8/60
SCALE		

DO NOT SCALE DRAWING
MAT'L
FINISH

DW-007899 REV. 00

PRODUCT | NEXT ASSEMBLY | QTY./ASSY.

REV	DATE	DESCRIPTION	BY
01	11/19/60	REVISED & REDRAWN	
02	3/29/61	ADDED NOTE FOR REF. DISCRIMINATOR. REMOVED SOUTHCO PART # ADDED SCOTCH	



FOR NORMAL OPERATION

CONNECT	TO PIN
INPUT	*A1
INPUT GROUND	*A1 SHIELD
SHORT	*4 & *6
OUTPUT	*4 & *6
OUTPUT GROUND	*17
105-125 AC, 55-65 CPS	*18 & *19
SHORT	*21 & *22
SHORT	*9, *16 & *24
SHORT	*A3 TO *A3 SHIELD

FOR AUTOMATIC TAPE SPEED COMPENSATION

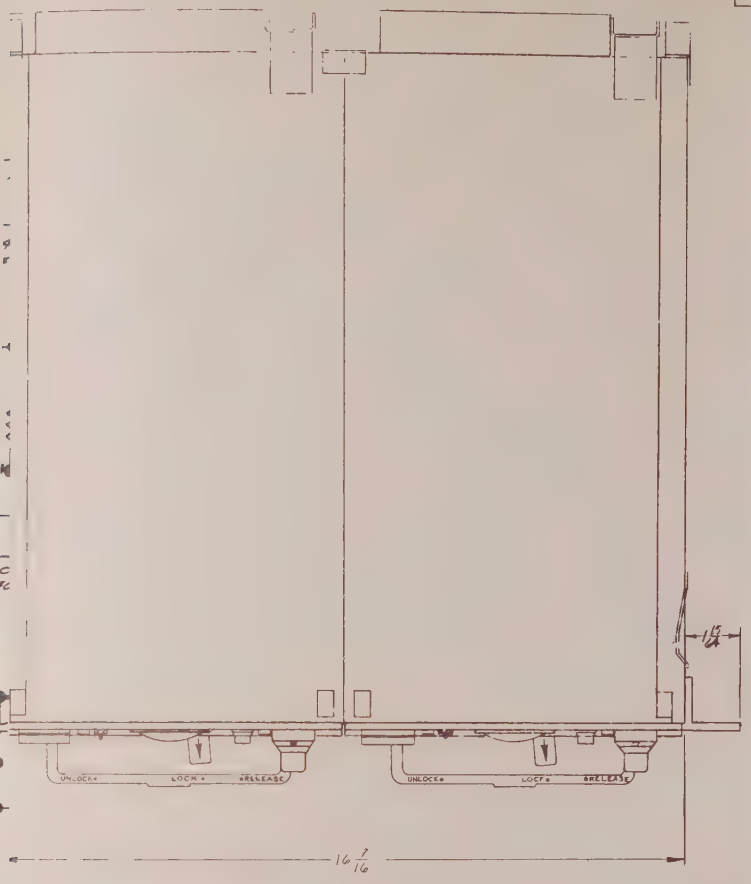
DISCONNECT	
PINS	*21 & 22

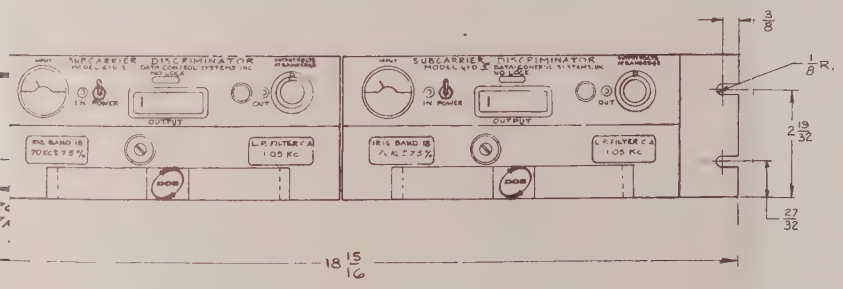
CONNECT	TO PIN
REF. DISCRIMINATOR OUTPUT	*21
REF. DISCRIMINATOR OUTPUT GROUND	*22

REF	DESCRIPTION	BY

DO-007415 | REV 02

ITEM	SYMBOL	DWG NO.	DESCRIPTION	QTY / ASSY





CANNON # DPX-25.C2W 22.55
EXTERNAL PLUG, FURNISHED WITH EQUIPMENT

P4 P A

PIN	DESCRIPTION
1.	INPUT & SHIELD
2.	VCO OUTPUT
3.	EXTERNAL ZERO OFFSET & SHIELD
4.	OUTPUT (VOLTAGE CONNECTION)
5.	AUTO CAL.
6.	OUTPUT (CURRENT CONNECTION)
7.	N.C.
8.	INPUT MONITOR
9.	AUTO CAL.
10.	INTERNAL GND BUSS (DO NOT USE)
11.	THERMAL RELAY
12.	THERMAL RELAY (CHASSIS GROUND)
13.	INTERNAL GND. BUSS (DO NOT USE)
14.	N.C.
15.	INTERNAL GRD. BUSS (DO NOT USE)
16.	AUTO CAL.
17.	OUTPUT GROUND
18.	115 V AC LINE
19.	115 V AC LINE
20.	INTERNAL GND BUSS (DO NOT USE)
21.	W&F INPUT
22.	INTERNAL GND BUSS (DO NOT USE)
23.	INTERNAL GND BUSS (DO NOT USE)
24.	AUTO CAL.
25.	AUTO CAL.

FOR AUTOMATIC STANDARDIZATION

CONNECT

5 - *9, 16, 24, A3 & A3 SHIELD

UNECT TO PIN

/ END OF GAIN POT - - - - - - - - *5

ER OF GAIN POT - - - - - - - - - *9

END OF GAIN POT - - - - - - - *25

PUT OF ZERO POT - - - - - - - *A3

NDARDIZATION GROUND - - - *A3 SHIELD

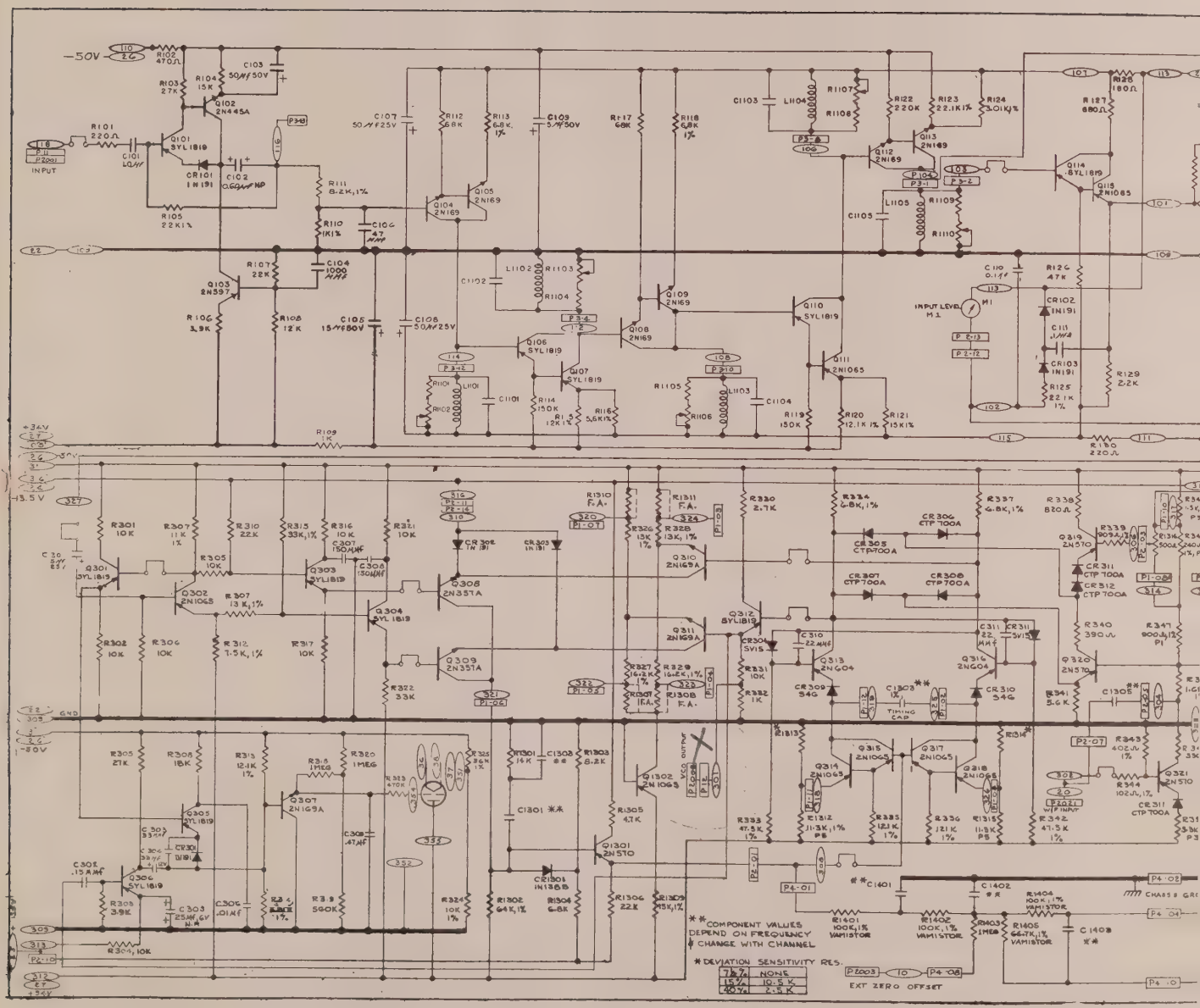
⚠ FOR REFERENCE DISCRIMINATOR
CONNECT AS IN NORMAL OPERATION.
ADD 100Ω 1% ELECTRADCM 1/2 WATT
DEPOSITED CARBON RESISTOR,
OR EQUIVALENT FROM PIN #4
TO PIN #5 OF DPX CONNECTOR

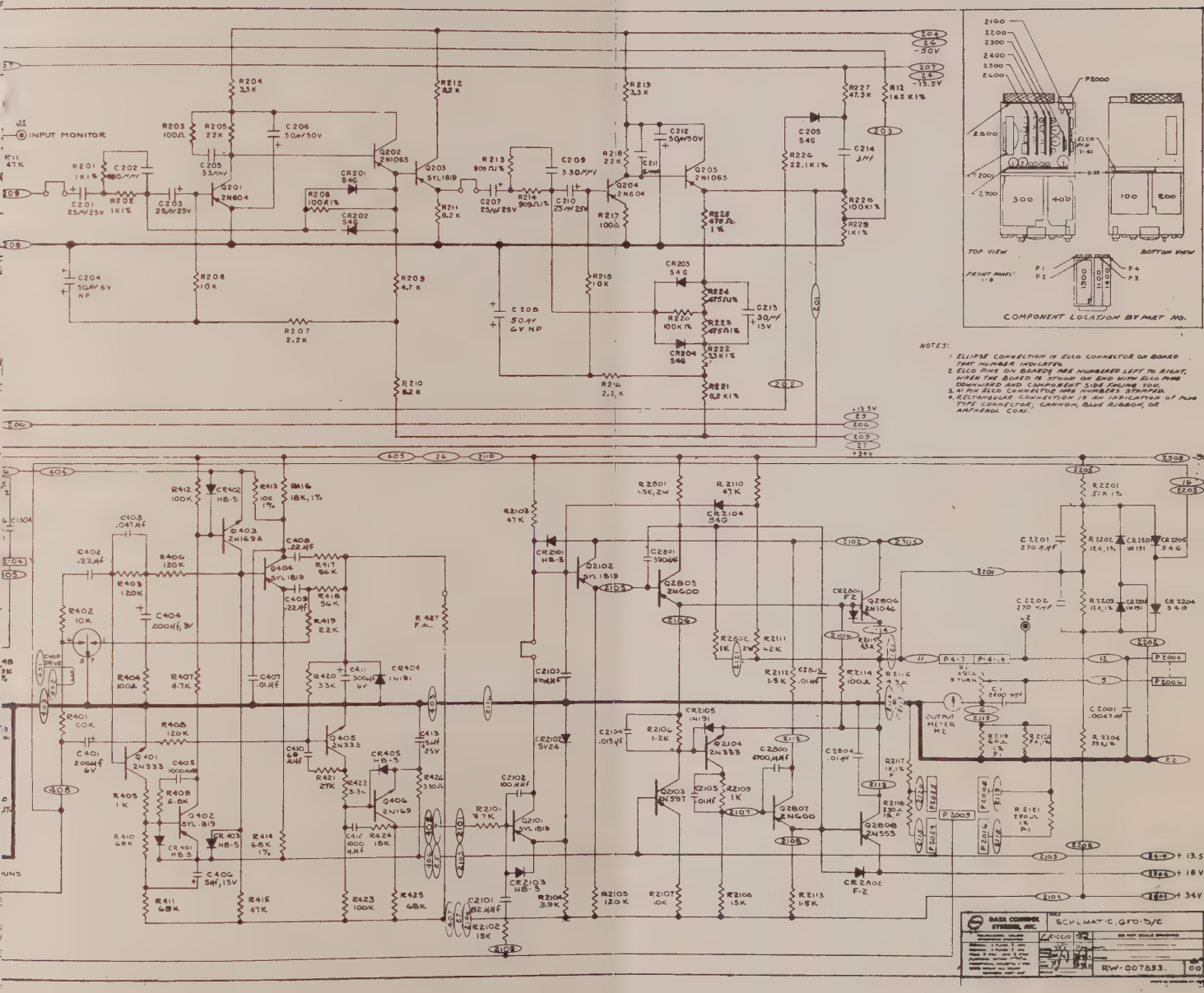
PRODUCT	NEXT ASSEMBLY	QTY / ASSY

DATA CONTROL SYSTEMS, INC.

TITLE: OUTLINE DRY N.A GFD-3

TOLERANCES UNLESS OTHERWISE SPECIFIED		DATE	DO NOT SCALE DRAWING
DECIMAL - 3 PLACE ± .005	DWN FES	12/1/59	
DECIMAL - 2 PLACE ± .010	CHKD R.J.B.B.	12/2/59	MAT'L
FRAC. ± 1/64 ANG. ± 0°30'	PROJ		
FLATNESS WITHIN ~ /IN.	ENG	1/31/59	FINISH
FRACTIONAL HOLES -0, + 1/64	CH ENG	2/24/59	
NOTE: BREAK ALL SHARP CORNERS .005"-.015"	SCALE 1/2	SIZE	DO-007415 REV 02


-50V
INPUT
Q101 SYL1819
Q102 2N4954
Q103 2N397
Q104 2N169
Q105 2N169
Q106 SYL1819
Q107 SYL1819
Q108 2N169
Q109 2N169
Q110 SYL1819
Q111 2N1065
Q112 2N169
Q113 2N169
Q114 SYL1819
Q115 2N1085
INPUT LEVEL M1
+34V
-13.5V
-50V
+13.5V
-80V
GND
Q301 SYL1819
Q302 2N1065
Q303 SYL1819
Q304 SYL 1819
Q305 SYL 1819
Q306 SYL1819
Q307 2N169A
Q308 2N357A
Q309 2N357A
Q310 2N169A
Q311 2N169A
Q312 SYL1819
Q313 2N604
Q314 2N604
Q315 2N1065
Q317 2N1065
Q318 2N1065
Q319 2N570
Q320 2N570
Q321 2N570
Q1301 2N570
Q1302 2N1063
CR101 1N191
CR102 1N191
CR103 1N191
CR302 1N191
CR303 1N191
CR304 SV15
CR305 CTP700A
CR306 CTP700A
CR307 CTP700A
CR308 CTP700A
CR309 546
CR310 546
CR311 CTP 700A
CR312 CTP 700A
CR1301 1N1368
R101 220Ω
R102 470Ω
R103 27K
R104 15K
R105 22K 1%
R106 3.9K
R107 22K
R108 12K
R109 1K
R110 11K 1%
R111 8.2K, 1%
R112 68K
R113 68K 1%
R114 150K
R115 12K 1%
R116 5.6K 1%
R117 68K
R118 68K 1%
R120 12.1K 1%
R121 715K 1%
R122 220K
R123 22.1K 1%
R124 3.01K 1%
R125 82.1K 1%
R126 47K
R127 680Ω
R128 180Ω
R129 2.2K
R130 220Ω
R301 10K
R302 10K
R303 11K 1%
R304 10K
R305 10K
R306 10K
R307 13K, 1%
R308 10K
R309 7.5K, 1%
R310 22K
R311 10K
R312 33K, 1%
R313 10K
R314 10K
R315 33K, 1%
R316 10K
R317 10K
R320 15K 1%
R321 10K
R322 33K
R326 2.7K
R327 16.2K 1%
R328 13K, 1%
R329 16.2K, 1%
R330 2.7K
R331 10K
R332 1K
R333 47.5K 1%
R334 6.8K, 1%
R335 36K 1%
R336 121K 1%
R337 6.8K, 1%
R338 820Ω
R339 909Ω, 1%
R340 390Ω
R341 5.6K
R342 47.5K 1%
R343 402Ω 1%
R344 102Ω, 1%
R347 900Ω, 1%
R1301 16K
R1302 64K, 1%
R1303 8.2K
R1304 6.8K
R1305 4.7K
R1306 22K
R1307 45K, 1%
R1308 F.A.
R1310 F.A.
R1311 F.A.
R1312 11.3K, 1% P8
R1313 121K 1%
R1314 11.8K P8
R1315 11.8K P8
R1401 100K, 1% VARISTOR
R1402 100K, 1% VARISTOR
R1403 1MEG
R1404 100K, 1% VARISTOR
R1405 66.7K, 1% VARISTOR
C101 1.0μF
C102 .0068μF NP
C103 50μF 50V
C104 1000 μμF
C105 15μF 50V
C106 .47 μμF
C107 50μF 25V
C108 50μF 25V
C109 5μF 50V
C110 0.1μF
C111 .1μF
C1101
C1102
C1103
C1104
C1105
C1106
C1107
C1108
C1109
C1110
L1101
L1102
L1103
L1104
L1105
C301 150μμF
C302 150μμF
C303 .25μF, 6V N.P.
C304 .01μF
C305 .15μF
C306 .01μF
C307 .47μF
C308 .47μF
C309 33μF
C310 22μF
C311 22 μμF
C1301 **
C1302 **
C1303 **
C1305 **
C1401 **
C1402 **
C1403 **
TIMING CAP
VCO OUTPUT
EXT ZERO OFFSET
CHASSIS GRD
** COMPONENT VALUES DEPEND ON FREQUENCY # CHANGE WITH CHANNEL
* DEVIATION SENSITIVITY RES.
7½% NONE
15% 10.5 K
30% 2.5 K


INPUT MONITOR
R11 47K
R201 1K1%
C202 680 MMF
R202 1K1%
C201 25MF 25V
C203 25MF 25V
Q201 2N604
R204 3.3K
R205 22K
R203 100Ω
C205 33MMF
C206 50MF 50V
Q202 2N1065
R208 100K1%
CR201 S4G
CR202 S4G
R212 8.2K
R211 8.2K
Q203 SYL1819
R213 909Ω1%
R214 909Ω1%
C207 25MF 25V
C209 330MMF
C210 25MF 25V
R218 22K
C211 5MMF
C212 50MF 50V
Q204 2N604
Q205 2N1065
R217 100Ω
R219 3.3K
R225 470Ω 1%
R227 47.3K
R12 162K1%
C205 S4G
R226 22.1K1%
C216 1MF
R228 100K1%
R229 1K1%
C204 50MF 6V NP
R206 10K
R207 2.2K
R209 4.7K
R210 8.2K
C208 50MF 6V NP
R215 10K
R216 2.2K
CR203 S4G
R224 475Ω1%
R220 100K1%
R223 475Ω1%
CR204 S4G
R222 33K1%
C213 30MF 15V
R221 8.2K1%
+13.5V
+34V
NOTES:
1. ELLIPSE CONNECTION IS ELCO CONNECTOR ON BOARD THAT NUMBER INDICATES.
2. ELCO PINS ON BOARDS ARE NUMBERED LEFT TO RIGHT, WHEN THE BOARD IS STOOD ON END WITH ELCO PINS DOWNWARD AND COMPONENT SIDE FACING YOU.
3. 41 PIN ELCO CONNECTOR AMP NUMBER 37PM41A.
4. RECTANGULAR CONNECTION IS AN INDICATION OF PLUG TYPE CONNECTOR, CANNON, BLUE RIBBON, OR AMPHENOL CORP.
2100
2200
2300
2400
2500
2600
2700
P2000
300
400
100
200
TOP VIEW
BOTTOM VIEW
FRONT PANEL
P1
P2
P3
P4
COMPONENT LOCATION BY PART NO.

R412 100K
CR402 HB-5
R413 10K 1%
R416 18K,1%
C403 .047MF
Q403 2N1692A
C408 .22MF
R406 120K
R417 56K
Q404 SYL 1819
C409 .22MF
R418 56K
R419 22K
C404 200MF, 3V
R403 120K
R402 10K
R427 F.A.
CHOP DRIVE
R404 100K
R407 4.7K
C407 .01MF
C411 300MF 6V
CR404 1N191
R420 33K
R401 60K
C401 200MF 6V
R408 120K
Q401 2N333
C405 1000MMF
Q405 2N333
C410 68 MMF
C413 .5MF 25V
R421 27K
R422 3.3K
CR405 HB-5
Q406 2N1692
R426 330Ω
R408 6.8K
Q402 SYL 819
CR401 HB-5
CR403 HB-5
R424 18K
C412 1000 MMF
R410 68K
R414 6.8K 1%
C406 5MF, 15V
R411 68K
R415 47K
R423 100K
R425 68K
C2101 82 MMF
R2102 15K
R2101 4.7K
Q2101 SYL 1819
C2102 100 MMF
CR2103 HB-5
R2104 3.9K
R2105 120K
R2107 10K
R2106 15K
R2113 1.5K
R2801 1.5K, 2W
R2110 47K
CR2104 S4G
R2108 47K
CR2101 HB-5
Q2102 SYL 1819
C2801 390MMF
Q2805 2N600
R2802 51K
R2111 4.2K
C2103 470MMF
R2112 1.5K
C2802 .01MF
R2114 100Ω
R2115 3.3K
C2803 .01MF
C2104 .015MF
R2104 1.2K
CR2105 1N191
Q2104 2N3823
C2800 6800MMF
Q2103 2N3397
R2105 10MF
R2109 1K
Q2807 2N600
Q2808 2N555
R2116 220Ω 1%
R2117 1K,1%
CR2102 SV24
CR2802 F-2
CR2001 F2
Q2806 2N1046
R2803 4.3K
R2801 51K 1%
C2201 270 MMF
R2202 12K,1%
CR2201 1N191
CR2205 S4G
C2202 270 MMF
R2203 12K,1%
CR2204 1N191
CR2204 S4G
P2004
P2006
OUTPUT METER M2
R2119 6.2K 1%
R2118 6.2K 1%
C2001 .0047MF
R2204 33Ω 1%
R2121 250Ω 1K P1
P2009
P2008
P2014
P2016
+13.5
+18V
+34V
DATA CONTROL SYSTEMS, INC.
SCHEMATIC, GFD-S/C
RICCO
DO NOT SCALE DRAWING
RW-007833

DCS FM DISCRIMINATORS AND ASSOCIATED EQUIPMENT

for Research Data Systems

Model GFD-3 Transistorized Subcarrier Discriminator, with Tuning Unit and Low-Pass Filter.

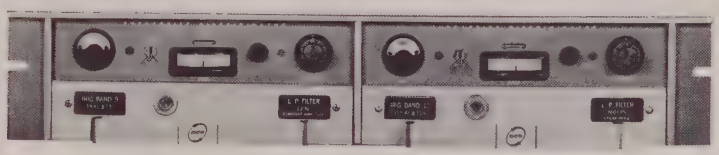
DCS

DATA-CONTROL SYSTEMS, INC.

San Francisco • Los Angeles • Orlando • Washington, D. C.
Home Office: 39 Rose Street, Danbury, Conn. • Pioneer 3-9241

DCS FM DISCRIMINATORS AND ASSOCIATED EQUIPMENT

for Research Data Systems



DCS research data systems feature completely transistorized Subcarrier Discriminators with associated plug-in units, with built-in provision for automatic compensation for tape-speed variations. A modular housing provides compact mounting for all units.

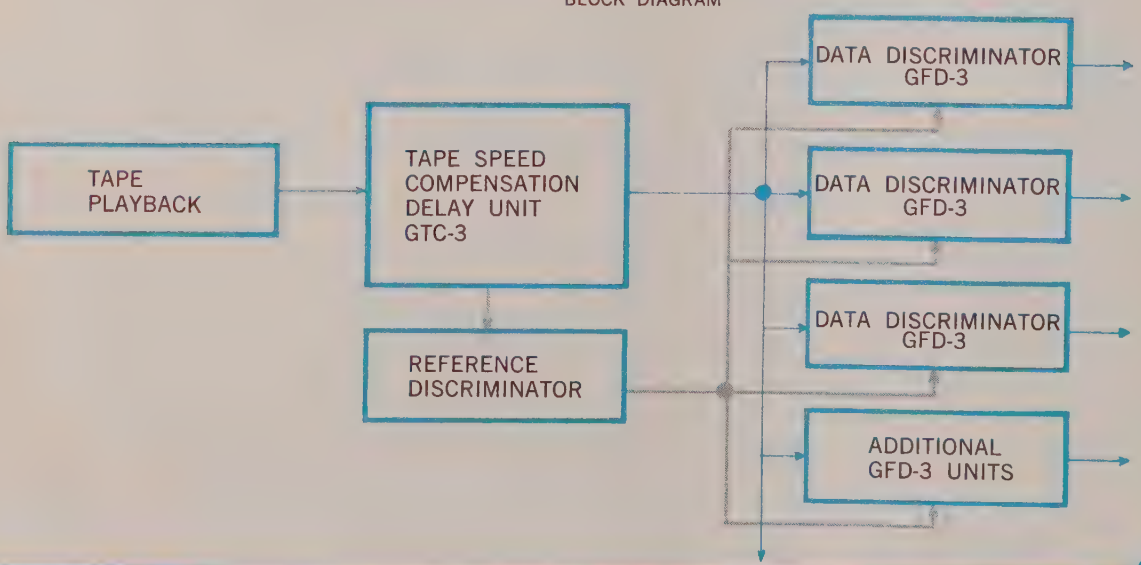
Each Subcarrier Discriminator includes its own easily replaceable modular power supply, thus eliminating cross-coupling, providing greater stability, lower noise content, and freedom from many-unit dependence upon a single power supply.

DCS Data Systems offer these specific advantages essential to reliable and efficient operation:

- Completely transistorized
- Long-life components
- Easily replaced plug-in circuit boards
- Readily accessible for maintenance
- Require less power
- More versatile
- Provide increased power output
- Higher sensitivity
- Extremely compact

TYPICAL FM GROUND STATION SYSTEM

BLOCK DIAGRAM



DCS

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MODEL GFD-3
TRANSISTORIZED
SUBCARRIER DISCRIMINATOR

FUNCTION:

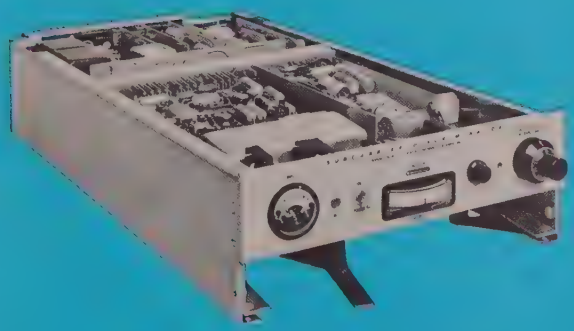
The Model GFD-3 Transistorized Subcarrier Discriminator and its associated filters select and demodulate a particular frequency-modulated signal from among a multiplex of several frequency-modulated signals. It is often employed in data systems based on standard IRIG* FM/FM subcarrier frequencies. It accepts input signals from a radio receiver, tape recorder, or any source of frequency-modulated signals. The discriminator output signal is displayed on an integral output meter, or it may be applied to any convenient external display or recording device, such as a pen-motor or galvanometer-type recorder.

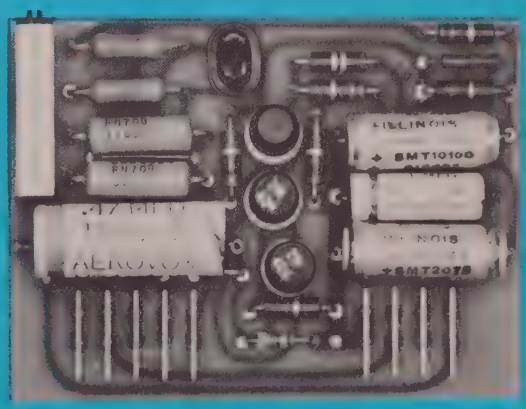
DESCRIPTION:

The Model GFD-3 is completely transistorized and is designed for maximum reliability. All components have been particularly selected to assure long-life and trouble-free performance. In addition, the GFD-3 and its associated tuning units, filter networks, etc., have been designed for maximum accessibility for maintenance. All circuit board assemblies are of the plug-in type for quick replacement as necessary. Wherever possible, the same circuit boards are used in several subassemblies, thereby reducing stocking requirements for replacement parts.

The GFD-3 circuit design incorporates the phase-lock loop principle which affords improved capability for detection of weak signals. The phase-lock technique improves the output signal-to-noise ratio when high values of modulation index are used at low subcarrier signal-to-noise ratios. The improvement achieved is particularly apparent for input signal-to-noise ratios lower than 10 db, and results from a reduction in the effective noise bandwidth. This reduction is achieved by means of a feedback loop which "phase locks" the output signal of a voltage-controlled oscillator within the discriminator to the input subcarrier signal. The local voltage-controlled oscillator is then said to "track" the subcarrier. The frequency response and effective noise bandwidth are correspondingly reduced.

**Inter-Range Instrumentation Group*





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PHASE-LOCK CIRCUIT ADAPTATIONS:

In recognition of the principles involved in phase-lock loop discriminators, two types of tuning units are offered for use with the Model GFD-3; both types contain a band-pass filter, loop filter, frequency determining network, tape compensation delay network, and a separate low-pass filter plug-in unit. The *Standard Tuning Unit* contains a fixed loop filter designed to permit full bandwidth step deviations without losing lock. When this Standard Tuning Unit is used, the Model GFD-3 is a superior replacement for pulse-averaging discriminators in common use. Particularly significant is the fact that the Standard Tuning Unit does not introduce the dynamic distortion often considered an inherent characteristic of phase-lock loop units. The *Variable-Loop Filter Tuning Unit* provides six switch positions which allow the operator to reduce the bandwidth in six steps by factors as large as 50. The Variable Loop Filter Tuning Unit permits optimum detection of threshold telemetry signals.

The Model GFD-3 will operate within specifications at carrier frequencies as high as 300 kc and accommodate intelligence spectra up to 35 kc. The small size, reduced power consumption, and rugged construction make the unit ideal for mobile installations and help to minimize space and cooling requirements in fixed installations.

PERFORMANCE SPECIFICATIONS:

Channel Frequencies:

IRIG channels or extrapolation of IRIG channels to 300 kc center frequency at ±7.5% or ±15% deviation are available on standard order. Channels with ±40% deviation are available on special order.

Adjacent Channel Rejection:

An adjacent channel signal 26 db larger than the desired signal produces less than 0.1% of bandwidth peak-to-peak output when the Standard Tuning Unit is used with its corresponding output filter for a modulation index of 5.0.

Time Delay Variation of Standard Tuning Unit:

Envelope delay of the input filter is 29.4° ±0.4° for intelligence limit frequency (M=5.0) in ±7.5% channels and 28.9° ±0.4° in ±15% channels.

Input Levels:

Inputs between 10 millivolts and 10 volts can be accommodated without adjustment.

Input Impedance:

Nominal one megohm shunted by approximately 50 μμf.

Amplitude Modulation:

A 20 db step change in signal level within the specified input range will produce less than 0.3% of bandwidth output when the output filter corresponding to a modulation index of 5.0 is used and the carrier is at band center.

Tape-Speed Compensation:

Tape-speed compensation delay networks are included in all tuning units. A tape-speed compensation *Reference Tuning Unit* converts any Model GFD-3 to a reference discriminator. Tape-speed compensation provides 30 db minimum attenuation of a flutter frequency equal to or less than the maximum signal frequency of any IRIG channel with modulation index of 5.0.

Linearity:

Independent linearity is ±0.05% of full bandwidth.

Dynamic Linearity:

Distortion of alternating inputs is less than 0.8% for modulation indices greater than 5.0.

Noise:

Output noise is less than 0.05% RMS of bandwidth for a modulation index of 5.0.

Drift:

Drift is less than 0.3% of bandwidth from best straight line over 12 hours after a 30-minute warm-up.

Output:

Output is continuously variable from ±1 volt to ±10 volts. Output current is 330 ma maximum regardless of output voltage. A nine-turn dial control of the output reads directly in band-edge voltage.

Output Limiter:

Output is limited to 14 volts maximum. Equipment protected against current overloads including short circuiting of the output.

PHYSICAL CHARACTERISTICS:

Power Input:

105-125 volts, 55-65 cps. 32 watts maximum per unit. (Each unit contains individual power supply.)

Controls and Indicators:

Input level meter, loop filter selector (on Variable Loop Filter Tuning Units only), output meter, nine-turn output level potentiometer, loss-of-lock indicator, power switch and pilot light, zero adjustment, and module lock.

Dimensions:

Two units mount side-by-side in a single 19½" rack modular housing Model GMH-3 and occupy 3½" of panel height.

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MODEL GFD-3/TU TUNING UNITS

FUNCTION:

Both the Standard and Variable Loop Filter Tuning Units serve four functions: (1) they adapt the associated discriminator to a particular subcarrier, selecting this subcarrier from a multiplex of several such subcarriers; (2) they incorporate provision for the addition of a low-pass intelligence frequency filter module appropriate to the subcarrier; (3) they contain circuits which provide automatic compensation of the discriminator output for variations in tape speed when used in a DCS tape-speed compensation system; (4) their modular configuration permits convenient interchangeability of tuning units within a subcarrier discriminator *from the front panel of the discriminator,* by a simple plug-in action. This configuration facilitates the use of any Tuning Unit with any discriminator and thus permits maximum flexibility in terms of ability to discriminate all IRIG subcarrier signals with a minimum number of discriminators.

DESCRIPTION:

(Standard Tuning Unit)

The Model GFD-3/TU Standard Tuning Unit is a five-pole band-pass filter designed to be used in the DCS Model GFD-3 Subcarrier Discriminator. These Tuning Units are available for all IRIG bands as well as special frequencies up to 300 kc. The frequency and deviation of each unit are marked on the front panel nameplate. Model GFD-3/TU contains the required circuitry for tape speed error compensation of the discriminator output.

The GFD-3/TU Tuning Unit contains a compartment to accommodate the Model GFD-3/TU/L Low-Pass Filter. The desired low-pass filter is selected and placed in the Tuning Unit before it, in turn, is inserted into the GFD-3.

PERFORMANCE SPECIFICATIONS:

(Standard Tuning Unit)

Tuning Units suitable for IRIG bands 1 through 18 are supplied to accommodate signals of ±7½% deviation from band center. Tuning Units suitable for IRIG bands A through E are supplied to accommodate signals of ±15% deviation from band center. Units corresponding to subcarrier frequencies of 54 kc, 27 kc, 13.5 kc to accommodate signals of 40% deviation are also available on request.

Note: 40% deviation units are not intended for use with an IRIG subcarrier multiplex input.

Phase Shift:

The intelligence phase shift is held constant over the pass-band to within ±0.4°, centered about 29.4° of intelligence for a modulation index of 5.0 for IRIG bands 1 through 18 centered about 28.9° for IRIG bands A through E.

Attenuation:

Attenuation of the subcarrier is down less than 3 db at the band edges; and down more than 28 db for ±7.5% bands and more than 26 db for ±15% bands at the band edge frequencies of the two adjacent IRIG bands.

Tuning Unit:

The Standard Tuning Unit will accommodate a full bandwidth step function input without losing lock. Frequency response of the loop filter combined with the band-pass filter is shown in the accompanying figure.

Frequencies Available:

Standard IRIG frequencies. Other frequencies available on special order.

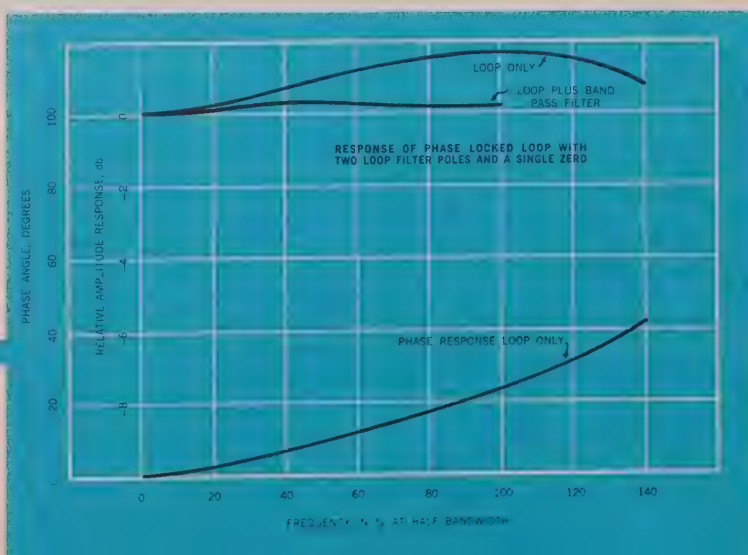
ORDERING INFORMATION:

Specify: (a) Standard Tuning Unit. DCS Model GFD-3/TU-(frequency and deviation).

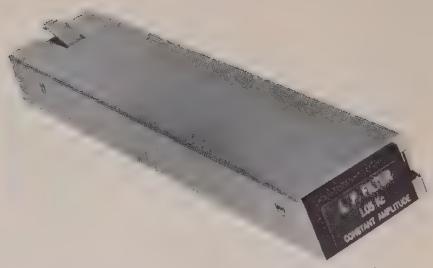
(b) Other requirements not standard.

or

(c) *Variable-Loop Filter Tuning Unit* DCS Model GFD-3/TU-(frequency and deviation) VL.



MODEL GFD-3/TU/L
LOW-PASS FILTER



FUNCTION:

The Low-Pass Filter acts upon the output signal from the DCS Subcarrier Discriminator, Model GFD-3, so as to yield an intelligence signal essentially free of any subcarrier frequency components.

DESCRIPTION:

The Low-Pass Filter consists of R-C frequency-determining feedback networks which function in conjunction with an operational amplifier within the GFD-3 Discriminator. It is modular in configuration and plugs into DCS Tuning Unit, Model GFD-3/TU. DCS Low-Pass Filters are available for all IRIG channels. Any Low-Pass Filter may be used with any Tuning Unit, provided the Low-Pass Filter has a specified cut-off frequency *less* than the highest intelligence frequency recommended in the IRIG Standards. Thus, IRIG channel 5 has a center frequency of 1300 cps and a recommended highest intelligence frequency of 20 cps. Standard Low-Pass Filters suitable for IRIG channels 1 through 5, having cut-off frequencies respectively of 6 cps, 8.4 cps, 11 cps, 14 cps, and 20 cps may be used.

PERFORMANCE SPECIFICATIONS:

Filter Characteristics:

The following types of low-pass filter characteristics and their designations are available in the standard IRIG frequencies. (Complete list available on request.) Other frequencies available on special order.

(1) Constant-Amplitude:

These filters have an amplitude response defined by the expression

$$A(\omega) = \frac{k}{\sqrt{1+\left(\frac{\omega}{\omega_c}\right)^6}}$$

(ω=intelligence frequency: ω_c=cut-off frequency of the filter). This is a three-pole filter with an 18 db per octave roll-off, and at least 18 db down at one octave above nominal cut-off frequency.

(2) Linear-Phase:

This filter approximates the "Gaussian" transfer T (ω) through the pass-band to its cut-off frequency:

$$T(\omega) = \text{Log}^{-1}\left[-.15\left(\frac{\omega}{\omega_c}\right)^2\right]$$

The amplitude versus frequency response characteristic is down 3 db at the nominal cut-off frequency and down 12 db one octave above this cut-off frequency. The asymptotic slope of the filter cut-off characteristic is 18 db per octave. Step function response exhibits less than 1% over-shoot. This filter is preferred over the constant-amplitude filter where transient response is of primary importance. This type of filter is normally used in commutated data channels where output decommutation equipment is used.

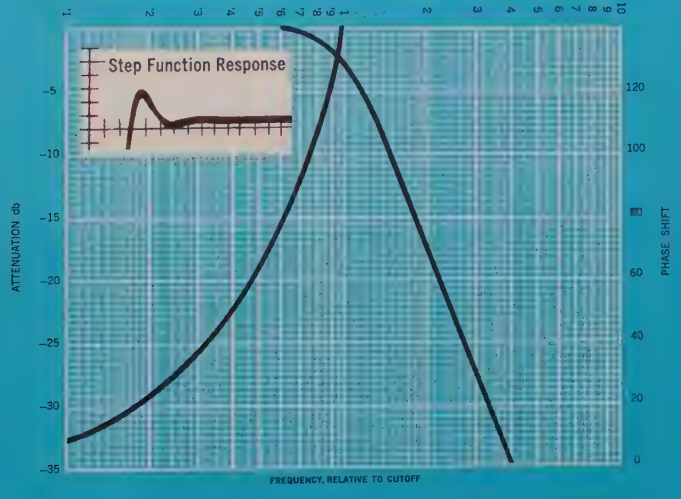
Measured characteristics lie within a rectangle whose amplitude dimension is equal to ±0.25 db and whose frequency dimension is ±1% cut-off frequency centered about the assumed frequency. For frequencies above 10 kc these dimensions increase to ±1 db and ±5%.

The flatness of the attenuation characteristic associated with a given channel may be improved by using the next higher Low-Pass Filter. This is accomplished, however, at the expense of wider noise bandwidth, as a consequence of the wider intelligence pass-band.

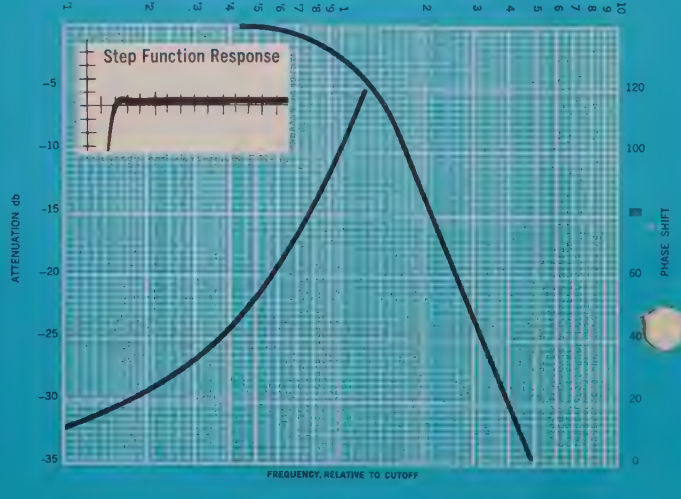
ORDERING INFORMATION:

Specify: (a) DCS Model GFD-3/TU/L Low-Pass Filter for Constant Amplitude, e.g., GFD-3/TU/L-(freq.)CA.
or
(b) Low-Pass Filter for Linear Phase, e.g., GFD-3/TU/L-(freq.) LP.

CHARACTERISTICS OF CONSTANT AMPLITUDE OUTPUT FILTER, MODEL GFD-3



CHARACTERISTICS OF LINEAR PHASE OUTPUT FILTER, MODEL GFD-3



MODEL GTC-3
TAPE-SPEED COMPENSATION UNIT
AND GTC-3/D DELAY LINE

TAPE-SPEED COMPENSATION UNIT, MODEL GTC-3

FUNCTION:

The Tape-Speed Compensation Delay Unit, GTC-3, is part of a complete tape-speed compensation system for use in the recovery of FM data which has previously been recorded on magnetic tape. This unit permits automatic compensation of the outputs of data discriminators for variations in tape speed during recording and playback, and provides for convenient front-panel adaptation of the system to various tape speeds and reference frequencies. *Separate adjustment of individual channels is not necessary.*

The Delay Unit and its associated Delay Line, Model GTC-3/D, introduce a fixed time delay of the FM signal multiplex equal to the time delay of the reference frequency through the reference discriminator. The signal multiplex is delayed prior to application of the multiplex to the data channel discriminators.

DESCRIPTION:

The Tape-Speed Compensation Delay Unit occupies one-half of a 3½" high rack modular housing (Model GMH-3) and is compatible with the GFD-3 Subcarrier Discriminator. The Delay Unit contains an input amplifier with automatic gain control, a plug-in Delay Line (Model GTC-3/D) and two output amplifiers capable of driving the capacitive load introduced by system wiring, without affecting the time delay introduced by the Delay Line.

PERFORMANCE SPECIFICATIONS:

Input Impedance:

33,000 ohms shunted by 50 $\mu\mu$f.

Input Range:

Input levels between 1 volt peak-to-peak and 10 volts peak-to-peak are accommodated automatically by the automatic gain control circuit.

Output:

Output is approximately 6 volts (±20%) peak-to-peak for specified input range. Peak-to-peak output current cannot exceed 25 milliamperes. Either capacitive or resistive loads can be tolerated.

Output Impedance:

10 ohms.

Frequency Response:

Frequency response is down less than 6 db at delay line cut-off frequency. Response is within 1 db of mid-band response at 300 cps.

Power Requirements:

105-125 volts, 55-65 cps, 10 watts.

Physical Dimensions:

Front panel: 3½" x 8". Overall depth: 16¼".

PHYSICAL SPECIFICATIONS:

Mounts in one-half of a GMH-3 unit which occupies 3½" of panel space.

ORDERING INFORMATION:

Specify: DCS Model GTC-3 Tape Compensation Delay Unit.

COMPENSATION DELAY LINE MODEL GTC-3/D

FUNCTION:

The Compensation Delay Line, GTC-3/D, adapts the DCS Tape-Speed Compensation Delay Unit, Model GTC-3, to a specified reference frequency. The Delay Line provides a fixed time delay of the signal multiplex corresponding to the delay of the reference signal through the reference discriminator.

DESCRIPTION:

The Delay Line is a plug-in module which fits into the front panel of the tape-speed compensation delay unit. It is available for various reference frequencies. Delay accuracy is within 0.4 electrical degrees of nominal intelligence cut-off frequency.

ORDERING INFORMATION:

Specify: (a) Model GTC-3/D Compensation Delay Line.
(b) Reference frequency (see table on next page), e.g., GTC-3/D-(ref. freq.).

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MODEL GFD-3/R
REFERENCE FREQUENCY TUNING UNIT

Function:

The Reference Frequency Tuning Unit is a plug-in module used in conjunction with a standard Model GFD-3 Subcarrier Discriminator, in place of the GFD-3/TU Tuning Unit and the GFD-3/TU/L Low-Pass Filter combination. The reference signal from the recorded FM multiplex is selected and demodulated; the voltage output from the Reference Discriminator is proportional to the variation in tape speed and is applied as compensatory bias to each Discriminator.

Performance Specifications:

The output of the reference discriminator with Reference Frequency Tuning Unit will compensate up to eighteen discriminators, simultaneously, for tape speed variations up to ±3%.

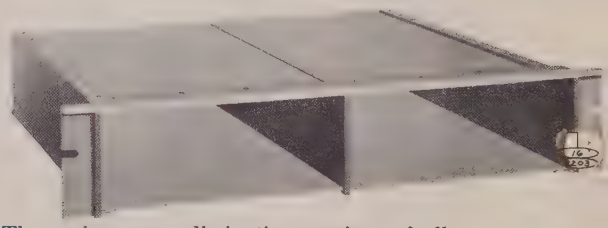
Ordering Information:

Specify: (a) Model GFD-3/R Reference Frequency Tuning Unit.
(b) Reference frequency (see table below), e.g., GFD-3/R-(ref. freq.).

Recommended Reference Frequencies

Reference Frequency	Highest Frequency Data Channel to be Compensated		Minimum Reqd. Tape Speed
100 kc	Channel 18	(70 kc ±7.5%)	60"/sec.
	Channel E	(70 kc ±15%)	
50 kc	Channel 16	(40 kc ±7.5%)	30"/sec.
	Channel B	(30 kc ±15%)	
17 kc	Channel 13	(10.5 kc ±7.5%)	15"/sec.

MODEL GMH-3
MODULAR HOUSING



The Model GMH-3 Modular Housing is required to mount DCS Discriminators and Tape-Speed Compensation Units conveniently in a standard 19" wide instrumentation rack. Each housing occupies 3½" of panel height, and is equipped with mating connectors.

An important design feature is the elimination of accessory slide mounts, since slide mounting of all DCS components is inherent in the design of both the components and housing.

The major power dissipating portions of all units that mount in the GMH-3 project from the rear of the unit; therefore cooling air must be provided between the back of the housing and the rear of the rack. The housing is made to mount all the basic components in the new DCS Ground Station System, in any combination.

DATA-CONTROL SYSTEMS

...designers and manufacturers of:

Telemetering and Research Data Systems and Components
Complete Telemetry Airborne and Ground Systems

- Fixed and switchable subcarrier discriminators
- Reference oscillators and mixers
- Tape speed compensators
- Amplifiers
- Voltage-controlled oscillators
- Electronic commutators
- Calibrators
- Automatic standardization systems
- Sensing devices
- Data display devices
- Remote control links (radio or wire)

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DATA-CONTROL SYSTEMS, INC.

RECOMMENDED SPARE PARTS LIST FOR GFD-3 DISCRIMINATORS

Serial Numbers 5360 and above

Item	Part Number	Location	Description	Qty. Per 6-9 Dis.	Unit Price	Total
1	328	Front Panel	Pilot Lamp, G. E.	2	.80	1.60
2	6977	Front Panel	Lock indicator, Amperex tube	1	8.60	8.60
3	BD-007954	Front Panel	Output level potentiometer, 500Ω, R1	1	29.00	29.00
4	CD-007572	Front Panel	Output meter, M2	1	55.20	55.20
5	CD-007810	Front Panel	Input Meter, M1	1	48.60	48.60
6	Special	---	Test cable for bench trouble-shooting	1	26.00	26.00
7	T-2104	Front Panel	Power switch, Hetherington	1	12.25	12.25
8	8118	GFD-3/C	Discriminator Board	2	325.00	650.00
9	8128	GFD-3/C	Limiter Board	1	169.00	169.00
10	9510	GFD-3/C	Low Pass Amplifier Board	1	212.00	212.00
11	8129	GFD-3/C	Band Pass Amplifier Board	1	186.00	186.00
12	7902	GFD-3 Pwr. Supply	Rectifier and Capacitor Board	1	74.00	74.00
13	7904	GFD-3 Pwr. Supply	Output Limiter Board	1	42.00	42.00
14	7906	GFD-3 Pwr. Supply	± 19 volt supply board	1	48.00	48.00

RECOMMENDED SPARE PARTS LIST FOR GFD-3 DISCRIMINATORS, Continued

Serial Numbers 5360 and above

Item	Part Number	Location	Description	Qty. Per 6-9 Dis.	Unit Price	Total
15	7908	GFD-3 Pwr. Supply	+ 34 volt supply board	1	126.00	126.00
16	7910	GFD-3 Pwr. Supply	± 14.5 volt supply board	1	48.00	48.00
17	9450	GFD-3 Pwr. Supply	Power Amplifier Board	2	125.00	250.00
18	7996	GFD-3 Pwr. Supply	- 52 volt supply board	1	80.00	80.00
19	GTF-1	---	Rack extension adaptor	1	150.00	150.00
20	3AG	GFD-3 Pwr. Supply	Fuse, Littlefuse, 1/2A, Slo-Blo, F2801	10	.60	6.00
21	9869	Power Supply	P. S. Chassis without plug-in boards	1	395.00	395.00
			Prices Subject To Change Without Notice.		TOTAL	$2,617.25

October/1967